National Advisory Committee for Aeronautics

Research Abstracts

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CURRENT NACA REPORTS

NACA TN 2867

HEAT AND MOMENTUM TRANSFER BETWEEN A SPHERICAL PARTICLE AND AIR STREAMS. Y. S. Tang, J. M. Duncan and H. E. Schweyer, University of Florida. March 1953. 48p. diagrs., photo., tab. (NACA TN 2867)

Heat-transfer coefficients for a spherical particle heated by an induction coil in a moving air stream were experimentally determined for the Reynolds number range from 50 to 1000 using spheres of 1/8- to 5/8-inch diameter and air velocities from 1 to 13 feet per second. A correlation of the heat-transfer factor or Stanton number with the Reynolds number was obtained and expressed by an empirical equation. This correlation is in agreement with the values calculated from theory for the lower range of Reynolds numbers studied. The skin-friction factor representing the momentum transfer calculated from the boundary-layer theory shows good agreement with the experimental heat-transfer factor except in the lower range of Reynolds numbers studied. The relationship $St = C_f/2$ where St is the Stanton number and C_f is the skin-friction factor is suggested for the case of an air stream flowing around a sphere. An empirical equation relating the heat-transfer factor to the total-drag coefficient is also suggested.

NACA TN 2890

A LINEAR TIME-TEMPERATURE RELATION FOR EXTRAPOLATION OF CREEP AND STRESS-RUPTURE DATA. S. S. Manson and A. M. Haferd. March 1953. 49p. diagrs. (NACA TN 2890)

A time-temperature parameter based on examination of the published stress-rupture data for a variety of materials is proposed in the form $(T - T_a)/(\log t - \log t_a)$, where T is temperature in degrees Fahrenheit, t is rupture time or the time to obtain a given total creep elongation, and T_a and $\log t_a$ are material constants which appear to be determinable from suitable rupture data in the time range between 30 and 300 hours. For the 40 materials investigated, use of this parameter in conjunction with experimental data involving rupture times below 300 hours resulted in very good extrapolations to longer rupture times (up to 10,000 hr where data were available) compared with corresponding predictions obtainable from a recently proposed parameter $(T + 460)(20 + \log t)$. For correlation of minimum creep-rate data, the parameter used is in the form $(T - T_a)/(\log r + \log r_a)$, where r is the creep rate and r_a is a material constant.

NACA TN 2902

MATRIX METHODS FOR DETERMINING THE LONGITUDINAL-STABILITY DERIVATIVES OF AN AIRPLANE FROM TRANSIENT FLIGHT DATA. James J. Donegan. March 1953. 65p. diagrs., 6 tabs. (NACA TN 2902)

Three methods are presented for calculating the longitudinal stability derivatives from transient flight data. Several examples using flight data are given to illustrate the method. The results indicate the scatter which is typical of this type of analysis.

NACA TN 2903

IMPINGEMENT OF CLOUD DROPLETS ON AERODYNAMIC BODIES AS AFFECTED BY COMPRESSIBILITY OF AIR FLOW AROUND THE BODY. Rinaldo J. Brun, John S. Serafini and Helen M. Gallagher. March 1953. 20p. diagrs. (NACA TN 2903)

The trajectories of water droplets in a compressible-air flow field around a cylinder were computed with a mechanical analog. The results of the calculations at the flight critical Mach number were compared with calculations of trajectories in an incompressible flow field. For a cylinder, the effect of compressibility of the air on the droplet trajectories was negligible up to the flight critical Mach number. The results obtained with the cylinder were extended to airfoils. This extension is possible because the incompressible flow fields of both cylinders and airfoils are similarly altered by compressibility.

NACA TN 2904

IMPINGEMENT OF WATER DROPLETS ON A CYLINDER IN AN INCOMPRESSIBLE FLOW FIELD AND EVALUATION OF ROTATING MULTICYLINDER METHOD FOR MEASUREMENT OF DROPLET-SIZE DISTRIBUTION, VOLUME-MEDIAN DROPLET SIZE, AND LIQUID-WATER CONTENT IN CLOUDS. Rinaldo J. Brun and Harry W. Mergler. March 1953. 71p. diagrs., photo., 4 tabs. (NACA TN 2904)

The trajectories of water droplets in an incompressible flow field around a cylinder were calculated with a mechanical analog. The collection efficiency, the area of droplet impingement on the cylinder, and the rate of droplet impingement were determined from the trajectories. An evaluation of the rotating multicylinder method for the measurement of droplet-size distribution, volume-median droplet size, and liquid-water content was made based on the results of the trajectory calculations.

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NACA TN 2910

AN APPLICATION OF THE METHOD OF CHARACTERISTICS TO TWO-DIMENSIONAL TRANSONIC FLOWS WITH DETACHED SHOCK WAVES. Keith C. Harder and E. B. Klunker. March 1953. 16p. diagrs. (NACA TN 2910)

An application of the method of characteristics is presented which affords a means for determining the surface pressures for a class of two-dimensional airfoils of given nose shape and arbitrary rear part in a sonic or supersonic stream if surface pressure data are given for one member of the class. For engineering purposes, the method of characteristics may be replaced by a simple application of Prandtl-Meyer flow concepts. An explanation of the nonlinear force characteristics of two-dimensional airfoils at transonic speeds is presented on the basis of sensitivity of these flows to changes in geometry and angle of attack.

NACA TN 2911

A LOW-SPEED EXPERIMENTAL STUDY OF THE DIRECTIONAL CHARACTERISTICS OF A SHARP-NOSED FUSELAGE THROUGH A LARGE ANGLE-OF-ATTACK RANGE AT ZERO ANGLE OF SIDESLIP. William Letko. March 1953. 27p. diagrs., photo. (NACA TN 2911. Formerly RM L52J14)

Static yawing moments and some instantaneous yawing moments are presented through a range of angle of attack at zero sideslip angle for a plain fuselage model having a sharp conical nose and for the fuselage with several nose modifications, one of which consisted of a ring located at different stations along the nose. Some circumferential pressure measurements at one station on the body at several angles of attack are also presented.

NACA TN 2912

THE NORMAL COMPONENT OF THE INDUCED VELOCITY IN THE VICINITY OF A LIFTING ROTOR AND SOME EXAMPLES OF ITS APPLICATION. Walter Castles, Jr. and Jacob Henri De Leeuw, Georgia Institute of Technology. March 1953. 38p. diagrs., 3 tabs. (NACA TN 2912)

A method is presented for computing the approximate values of the normal component of the induced velocity at points in the flow field of a lifting rotor. Tables and graphs of the relative magnitudes of the normal component of the induced velocity are given for selected points in the longitudinal plane of symmetry of the rotor and on the lateral rotor axis. A method is also presented for using the tables and graphs to determine the interference induced velocities arising from the second rotor of a tandem- or side-by-side-rotor helicopter and the induced flow angle at a horizontal tail plane.

NACA TN 2913

ON THE DEVELOPMENT OF TURBULENT WAKES FROM VORTEX STREETS. Anatol Roshko, California Institute of Technology. March 1953. 77p. diagrs., photos., 3 tabs. (NACA TN 2913)

Wake development behind circular cylinders at Reynolds numbers from 40 to 10,000 was investigated by hot-wire techniques in a low-speed wind tunnel. The Reynolds number range of periodic vortex shedding is divided into two distinct subranges. In the stable range, R = 40 to 150, regular vortex streets are formed and no turbulent motion develops, the vortices decaying by viscous diffusion. The range R = 150 to 300 is a transition region to the irregular range in which turbulent velocity fluctuations accompany the periodic formation of vortices. The diffusion is turbulent and the wake becomes fully turbulent in 40 to 50 diameters. The turbulence is initiated by laminar-turbulent transition in the free layers which spring from the separation points on the cylinder. An annular vortex street was observed in the wake of a ring.

NACA TN 2914

A METHOD FOR RAPID DETERMINATION OF THE ICING LIMIT OF A BODY IN TERMS OF THE STREAM CONDITIONS. Edmund E. Callaghan and John S. Serafini. March 1953. 33p. diagrs. (NACA TN 2914)

The effects of existing frictional heating were analyzed to determine the conditions under which ice formations on aircraft surfaces can be prevented. A method is presented for rapidly determining by means of charts the combination of Mach number, altitude, and stream temperature which will maintain an ice-free surface in an icing cloud. The method can be applied to both subsonic and supersonic flow. The charts presented are for Mach numbers up to 1.8 and pressure altitudes from sea level to 45,000 feet.

NACA TN 2915

EFFECT OF PROCESSING VARIABLES ON THE TRANSITION TEMPERATURE, STRENGTH, AND DUCTILITY OF HIGH-PURITY, SINTERED, WROUGHT MOLYBDENUM METAL. Kenneth C. Dike and Roger A. Long. March 1953. 26p. diagrs., photos., 3 tabs. (NACA TN 2915)

High-purity, sintered, wrought molybdenum metal has a transition temperature range near room temperature which varies according to the amount of swaging reduction; increasing swaging reduction decreases the transition temperature range. Recrystallized metal possesses a higher transition temperature range than as-swaged metal, regardless of the amount of prior working. Ultimate tensile strengths of as-swaged, stress-relieved, or recrystallized metal are affected by varying amounts of working from 35 to 99 percent swaging reduction, but the differential is not large. Ductility of as-swaged metal at room temperature increases with increased working; however, when stress-relieved, the ductility does not vary with working. Recrystallized metal has good ductility above the transition range

provided that the prior working is greater than about 50 percent. Other data are presented as to grain size, type of fracture, and chemical analysis.

NACA TN 2917

A MODIFIED REYNOLDS ANALOGY FOR THE COMPRESSIBLE TURBULENT BOUNDARY LAYER ON A FLAT PLATE. Morris W. Rubesin. March 1953. 23p. diagrs., tab. (NACA TN 2917)

A modified Reynolds analogy is developed for the compressible turbulent boundary layer on a flat plate. When mixing-length theories are used to evaluate terms of the final expressions, it is found for air that the ratio of Stanton number to half the local skin-friction coefficient is greater than unity. At Mach number equals zero, this ratio is of the order of 1.18 to 1.21 for Reynolds numbers based on momentum thickness of 10^3 to 10^6. Up to a Mach number of 5 and under extreme conditions of surface temperature, it is found that the ratio of Stanton number to half the skin-friction coefficient differs from its values for the incompressible case (M = 0) by amounts so small as to be of the magnitude of the uncertainties in the theory.

NACA TN 2918

EFFECTS OF PARALLEL-JET MIXING ON DOWNSTREAM MACH NUMBER AND STAGNATION PRESSURE WITH APPLICATION TO ENGINE TESTING IN SUPERSONIC TUNNELS. Harry Bernstein. March 1953. 26p. diagrs., photos. (NACA TN 2918)

A one-dimensional analysis of the results of the parallel-jet mixing encountered in the testing of engines in supersonic wind tunnels is reported. This type of analysis presents a reasonable approach to obtaining approximate figures for the tunnel operating conditions while the tunnel is still in the design stage. These figures would be based upon the known tunnel geometry and inlet conditions and estimations of the model geometry and values of the engine performance parameters. Additional equations are presented for evaluation of changes due to the burning of excess fuel downstream of the engine-exhaust station.

NACA TM 1355

STUDY OF THE SUPERSONIC PROPELLER. (Étude de L'Hélice Supersonique). Jean Fabri and Raymond Siestrunck. March 1953. 23p. diagrs. (NACA TM 1355. Trans. from Ministère de l'Air. Publications Scientifiques et Techniques 248, 1951, p. 113-130; International Conference on Mechanics, Proceedings, v. 1, 1950).

In this paper a propeller having all sections operating at supersonic speeds is designated a supersonic propeller regardless of flight speed. Analyses assume subsonic flight speeds but very high rotational speeds. A very elementary analysis of the efficiency of a jet-propeller system is presented. A propeller analysis based on conventional vortex blade element theory is presented and reduced to a single point method which leads to an expression for optimum advance ratio in terms of hub-tip diameter ratio and airfoil fineness ratio. An expression for propeller efficiency in terms of advance ratio, hub-tip diameter ratio, and airfoil thickness ratio is also presented. Use is made of theoretical airfoil characteristics at supersonic speeds. A study of blade section interference, blade shock and expansion fields, at supersonic section speeds is presented. An example taken indicates that an efficiency of seventy percent can be obtained with a propeller having a tip Mach number of 2.3.

BRITISH REPORTS

N-21075*

Royal Aircraft Establishment (Gt. Brit.)
COMMUNICATION IN THE PRESENCE OF NOISE. D. J. Richardson. October, 1952. 29p. (RAE Tech. Note GW 215)

This report is divided into three main parts. The first part considers discrete information, and a number of theorems on discrete information are developed. The second discusses continuous information, and shows how the various theorems on discrete information may be generalized to apply to the continuous case. An information potential measure is introduced. The third is concerned with the transfer of continuous information in the presence of noise.

N-21206*

Aeronautical Research Council (Gt. Brit.)
THE CALCULATION OF AERODYNAMIC DERIVATIVE COEFFICIENTS FOR WINGS OF ANY PLAN FORM IN NON-UNIFORM MOTION. W. P. Jones. 1952. 12p. diagrs., tab. (ARC R & M 2470. Formerly ARC 10, 142; 0.623; FM 1030; S & C 2074)

In the present paper, a method is outlined for the calculation of aerodynamic forces on wings of any plan form in steady or unsteady motion. It is based on vortex sheet theory for thin wings as developed by the writer in previous reports, but makes use of Falkner's scheme for the approximate calculation of downwash distributions. In the earlier work, satisfactory agreement with the experimental evidence available was obtained, but as the downwash distributions were calculated exactly the numerical work was rather complicated and involved the use of incomplete elliptic integrals and the treatment of singularities. The method now proposed avoids these computational difficulties and is perhaps more suitable for routine calculations of flutter derivatives. Satisfactory solutions of many problems in steady motion have already been obtained by Falkner using approximate downwash distributions as determined by his vortex lattice, and it is thought that the similar scheme suggested in this paper might also prove to be sufficiently accurate for problems in unsteady motion. The computational procedure is briefly summarized

in appendix II. Certain modifications of the main scheme which would further reduce the amount of computation are indicated in the main text.

N-21207 *

Aeronautical Research Council (Gt. Brit.)
PART I. TABULATED THERMAL DATA FOR HYDROCARBON OXIDATION PRODUCTS AT HIGH TEMPERATURES. PART II. THE EFFECT OF DISSOCIATION ON ROCKET PERFORMANCE CALCULATIONS. A. B. P. Beeton. 1952. 14p. diagrs., 3 tabs. (ARC R & M 2542. Formerly RAE Tech. Note Aero 1835; SD 40; RAE Tech. Note Aero 1838; SD 42)

Tables are given of the total heat and entropy of H_2O, CO_2, O_2, CO, H_2, OH, O, and H for the range of temperature 1500°-4000° K. Values are also given for the corresponding equilibrium constants over the same temperature range. The tables have been compiled with a view to their use in calculating the performance of liquid-fuel rockets.

N-21208 *

Aeronautical Research Council (Gt. Brit.)
FLIGHT TESTS ON HURRICANE II, Z.3687 FITTED WITH SPECIAL WINGS OF 'LOW-DRAG' DESIGN. R. H. Plascott, D. J. Higton, F. Smith and A. R. Bramwell. 1952. 13p. diagrs. (ARC R & M 2546; ARC 9172; ARC 10,106. Formerly RAE Aero 2090; Aero 2153)

This report describes flight tests to investigate the profile-drag characteristics of a "low-drag" section wing built by Armstrong Whitworth, Ltd., using a new type of construction of their own design. During the first series of tests, a section of the wing was pressure-plotted and the results showed that it should be possible to obtain laminar flow over a range of lift coefficient from 0.12 to 0.50. A few preliminary profile-drag measurements were also made and a fairly low profile-drag coefficient (C_D = 0.0046 to 0.0050) was recorded over a lift coefficient range of 0.20 to 0.40; there was, however, a rapid rise in the profile drag coefficient at lift coefficients less than 0.20, and investigation of the surface waviness showed that the failure to maintain laminar flow at higher speeds was probably due to the excessive waviness present, which amounted to a variation of about ±2-1/2 thousandths of an inch from the mean deflection curve on a two-inch gage length. A further series of profile-drag measurements was made when the surface waviness had been reduced to ±1 thousandth of an inch variation from the mean deflection curve on a 2-inch gage length. It was found that, provided no flies or other insects were picked up during the flight, the drag coefficient had been reduced to 0.0044 over a range of lift coefficient from 0.12 to 0.50. This corresponds to transition from 50 to 60 percent chord. With the reduced surface waviness, it was possible to maintain laminar flow up to Reynolds numbers of nearly 20 millions.

N-21209*

Aeronautical Research Council (Gt. Brit.)
TESTS IN THE COMPRESSED AIR TUNNEL ON THE AEROFOILS NACA 0015 AND NACA 0030 WITH AND WITHOUT SPLIT FLAP AND ON OTHER AEROFOILS OF VARIOUS THICKNESSES WITH A SPLIT FLAP. R. Jones. 1952. 32p. diagrs., 16 tabs. (ARC R & M 2584. Formerly ARC 4191; ARC 4511; ARC 4607)

This report contains the results of experiments to determine the effect of thickness on the aerodynamic characteristics of a group of rectangular wings with and without a split flap. Wings with the following airfoil sections were tested: NACA 0015 and NACA 0030 with and without a split flap; NACA 0012, NACA 23012, RAF 28 and RAF 48 with the flap. The effect of rounding the edge of the flap was considered on the wing with NACA 0015 section. The effect of rounding the ends of the NACA 0030 section was examined. C_L, C_D, and C_m were obtained over a range of Reynolds numbers with additional C_D measurements at closer intervals of R on the two wings without flap.

N-21210*

Aeronautical Research Council (Gt. Brit.)
THE EFFICIENCY OF A PITOT INTAKE INCLINED TO THE AIR STREAM. E. L. Place and R. Lecavalier. 1952. 8p. diagrs. (ARC R & M 2621; ARC 11,162. Formerly NGTE Memo. M. 21)

In an earlier report on intake ducting for supersonic flight, the efficiency of a "pitot" type intake was discussed and shown to have a marked effect on the performance of gas-turbine engines. The present report is supplementary in that it describes the effect of inclining the pitot intake to the main airstream direction in the transonic Mach number range 0.7 to 1.5, an effect which is at present incalculable. Curves are presented showing the influence of inclination on intake adiabatic efficiency and air mass flow into the intake. These experimental results are then illustrated by application to the performance of a typical turbine engine and a propulsive duct in sonic and supersonic flight. At a flight Mach number of 1.5, it is found that, for both turbine engine and propulsive duct, an inclination of 5° reduces the net thrust by roughly 2 percent compared with the normal flight thrust. For inclinations greater than 5°, however, thrust falls off more rapidly, and at 10° inclination, it is reduced by roughly 6.5 percent for the turbine engine and 7.5 for the propulsive duct.

N-21211*

Aeronautical Research Council (Gt. Brit.)
REGENERATOR HEAT EXCHANGERS FOR GAS-TURBINES. J. E. Johnson. 1952. 72p. diagrs., 13 tabs. (ARC R & M 2630; ARC 11,770. Formerly RAE Aero 2266; SD 27)

Information was required from which the performance of regenerators suitable for heat exchangers for gas turbines could readily be estimated. A series of

tables and curves have been prepared from which the efficiency of a regenerator can be calculated if the operating conditions and heat-transfer coefficients are known. The tables and curves cover a range of lengths and blow times appropriate to gas-turbine conditions. Measurements of heat transfer and pressure drop coefficients have been made on several examples of matrix of both the gauze and flame trap type in conditions similar to those in a gas turbine. A number of examples have been worked out from the experimental results to show the relative importance of the different variables on the performance of typical regenerators. A gauze matrix of fine wire and open mesh has a much lower weight and only slightly higher pressure drop than a flame-trap matrix for the same efficiency. The recommended size of gauze is a wire diameter of 0.002 in. to 0.004 in. and a mesh of 20 to 40 wires per inch; the material should be stainless steel. Further design study is necessary to determine whether this advantage can be maintained in a complete regenerator.

N-21212*

Aeronautical Research Council (Gt. Brit.)
COMPARATIVE FLUTTER TESTS ON TWO, THREE, FOUR AND FIVE-BLADE PROPELLERS. H. G. Ewing, J. Kettlewell and D. R. Gaukroger. 1952. 8p. diagrs. (ARC R & M 2634; ARC 11,438. Formerly RAE Structures 18)

This report describes comparative flutter tests on two-, three-, four-, and five-blade Duralumin propellers with the same blade design. The tests were made on the No. 3 spinning tower, Royal Aircraft Establishment. Strain gages were used for determining the vibratory stresses and the phase relations between the blades. A wide range of blade angles above and below the stalling region was explored. Stalling flutter was the only form encountered. The phase relation of the blades was found to be dependent on number of blades and speed of rotation, and to influence the amplitude of the vibratory stresses. It is shown that no direct comparison of the flutter characteristics of the two-, three-, four-, and five-blade propellers can be made.

N-21213*

Aeronautical Research Council (Gt. Brit.)
CONCERNING THE ANNULAR AIR INTAKE IN SUPERSONIC FLIGHT. I. M. Davidson and L. E. Umney. 1952. 22p. diagrs., photos. (ARC R & M 2651; ARC 11,645. Formerly NGTE R. 16)

The stability of an annular air intake at a Mach number of 1.4 and with Reynolds numbers of about 1.5×10^6 is considered in detail and a method is described whereby the experimental results might be extrapolated for preliminary full-scale design purposes. This extrapolation has yet to be checked experimentally, but suggests that a typical aircraft intake would have an over-all isentropic efficiency of about 85 percent. The results also indicate that both the stability and the efficiency of an intake could be improved by controlling the boundary layer on its nacelle, and as an alternative to boundary-layer suction a device which is described as a segregation ring is suggested. This, it appears, might raise the efficiency by some 2 or 3 percent.

N-21214*

Aeronautical Research Council (Gt. Brit.)
THE PHYSICAL CHARACTERISTICS OF WIRE RESISTANCE STRAIN GAUGES. Eric Jones and K. R. Maslen. 1952. 44p. diagrs., photos., 4 tabs. (ARC R & M 2661; ARC 12,357. Formerly RAE Instn. 2)

This report deals with the fundamental principles of the wire resistance strain gage. Types of strain gage in common use and their methods of construction are described, and the mechanism whereby strain effects change of resistance is discussed. A subsection is devoted to the behavior of fine wires, in general, under strain. Possible causes of error, including the effects of humidity and temperature, are discussed, and as far as possible methods are given of overcoming these difficulties. The effect of the passage of current on the strain gages is described, and methods of increasing the output are suggested. The final section is devoted to miscellaneous properties of the wire resistance strain gage, on several of which very little information is at present available.

N-21215*

Aeronautical Research Council (Gt. Brit.)
THEORETICAL INVESTIGATIONS OF TERNARY LIFTING SURFACE - CONTROL SURFACE - TRIMMING TAB FLUTTER AND DERIVATION OF A FLUTTER CRITERION. H. Wittmeyer. 1952. 42p. diagrs., 3 tabs. (ARC R &M 2671; ARC 12,043. Formerly RAE Structures 19)

Theoretical investigations have been made of the flutter of an idealized trimming tab system having three degrees of freedom - normal translation of the main lifting surface, rotation of the control surface, and rotation of the tab. All the structural parameters of the system have been varied except the out-of-balance moment of the control surface. The cases in which the system is free from flutter have been particularly investigated. From these investigations, criteria for the avoidance of flutter have been derived. If the structural parameters of the system satisfy these criteria, flutter of the system with these three degrees of freedom should be impossible. The results are applicable to trimming tabs, servotabs with zero follow-up ratio, and generally to all systems in which the tab can be regarded as connected elastically only to the control surface.

N-21217*

Aeronautical Research Council (Gt. Brit.)
FLOW THROUGH A HELICOPTER ROTOR IN VERTICAL DESCENT. P. Brotherhood. 1952. 14p. diagrs., photos. (ARC R & M 2735; ARC 11,837. Formerly RAE Aero 2272)

Flight tests have been made on a Hoverfly I helicopter to investigate the types of flow associated with various rates of vertical descent. At the same time, measurements of the performance were made. The results are analyzed by two different methods to produce characteristic curves for the rotor and are compared with data obtained from wind-tunnel tests on model propellers at negative rates of advance. The information was obtained from the Hoverfly I helicopter but it is thought that the results can be applied to any other helicopter of similar size.

N-21218*

Aeronautical Research Council (Gt. Brit.)
LOW-SPEED WIND-TUNNEL TESTS OF FOWLER FLAPS, SLATS AND NOSE FLAPS ON A MODEL OF A JET AIRCRAFT WITH A 40 DEG SWEPT-BACK WING. A. Spence. 1952. 18p. diagrs., 6 tabs. (ARC R & M 2752; ARC 12, 131. Formerly RAE Aero 2302)

This report presents the results of tests with Fowler flaps on a model of a single-jet aircraft with a 40° sweptback 10-percent-thick wing. Slats and nose flaps were also tested as means of delaying the tip stall. The maximum trimmed lift coefficient without flaps or slats was 1.055 ($R = 2.7 \times 10^6$). With half-span Fowler flaps (leaving a gap across the fuselage) and slats over the outer half of the span, this value was increased to 1.64, and there was adequate stability. Tests in which the spanwise extent of the nose flap was varied, indicated that about 50 percent wing semispan per side was the optimum length of slat or nose flap for avoiding instability at the stall.

N-21219*

Aeronautical Research Council (Gt. Brit.)
NOTE ON THE INFLUENCE OF ASPECT RATIO ON THE VARIATION WITH MACH NUMBER OF THE LIFT AND HINGE-MOMENT CHARACTERISTICS OF A WING AND FULL-SPAN CONTROL. A. D. Young and P. R. Owen. 1952. 6p. diagr., tab. (ARC R & M 2767; ARC 7046; ARC 7133. Formerly RAE Tech. Note Aero 1250; RAE Tech. Note Aero 1263)

It is shown on the basis of the linearized theory that the effects of compressibility on the lift and hinge-moment characteristics of a wing and full-span control are functions of aspect ratio. With reduction in aspect ratio, the increase of the lift characteristics with Mach number is reduced appreciably. The same effect is noted for the hinge-moment characteristic b_1. The effects on the hinge-moment characteristics b_2 and b_3 are rather more complicated, but in many practical cases the influence of aspect ratio will be very small.

N-21258*

Royal Aircraft Establishment (Gt. Brit.)
THE YOUNG'S MODULUS, POISSON'S RATIO AND RIGIDITY MODULUS OF SOME ALUMINIUM ALLOYS. PART II. N. Dudzinski. November 1952. 28p. photos., 14 tabs. (RAE Met. 69)

Various binary and ternary chill-cast or sintered aluminium alloys were prepared and their elastic properties investigated. It was found that the nitrides of aluminium, chromium, magnesium, iron, vanadium, titanium, and zirconium caused an appreciable increase in Young's modulus. Ternary intermetallic compounds showed a similar effect. The specific Young's modulus value was improved by the additions of chromium or manganese. The rigidity modulus value in torsion was similar to that calculated from E and Poisson's ratio. The effect of composition and the heat of formation of various intermetallic compounds is discussed.

N-21259*

Ministry of Supply (Gt. Brit.)
ALUMINIUM-COPPER-CADMIUM SHEET ALLOYS. H. K. Hardy. May 22, 1952. 25p. diagrs., photos., 13 tabs. (MOS S & TM 9/52; Fulmer Research Institute Ltd.)

Aluminum-copper-cadmium alloys have been rolled to sheet on a semitechnical scale and showed an exceptional capacity for hot work. The aging characteristics have been examined and an uncoated alloy with 5 percent copper-0.15 percent cadmium gave 25 tons/sq in. for the 0.1 percent proof stress and 30 tons/sq in. maximum stress in both the transverse and longitudinal directions. Cold working prior to artificial aging markedly raised the tensile properties of aluminum-copper alloys but had the unique effect of reducing the properties of the aluminum-copper-cadmium alloys. The proof stress can drop by 3 tons/sq in. but the effect can be prevented if the alloy is given a short partial aging ("incubation") treatment at 165° or 170° C before cold working. Aluminum-copper alloys showed a marked susceptibility to stress corrosion resulting from severe intercrystalline corrosion. Aluminum-copper-cadmium alloys were immune from stress corrosion and showed an intracrystalline attack when sprayed with 3 percent sodium chloride solution.

N-21262*

Aeroplane and Armament Experimental Establishment (Gt. Brit.) AN INVESTIGATION INTO THE PITOT RAKE METHOD OF MEASURING TURBO JET ENGINE THRUST IN FLIGHT. J. Stephenson, R. T. Shields and D. W. Bottle. December 23, 1952. 56p. diagrs., 9 tabs. (AAEE/Res/265)

Tests have been made to establish whether a pitot rake could be used as an absolute measure of the thrust of a jet engine on the ground and in flight. The tests were made to investigate errors due to the assumptions inherent in the single pitot method of estimating thrust in flight, and to establish if a rake can be used to calibrate the single pitot of an uncalibrated engine installed in an aircraft. The tests were also planned to check the generally accepted nondimensional thrust relationship for jet engines. The tests were made on Derwent 5 engines installed in Meteor 4 aircraft. The tests covered a wide range of flight conditions and included test bed

measurements on bare engines and later, measurements of exit static pressure. Although the tests could not all be made on the same engine, the same final nozzle was used in all the main tests. The main conclusions were: (1) Static tubes must be incorporated in the pitot rake to give absolute thrust measurements and even so a discrepancy of 2 percent requires further investigation. (2) The single pitot method of estimating flight thrust based on engine test bed calibration was in error by as much as 6 percent due to changes in total pressure sampled by the single pitot and in the magnitude of the exit static pressure between calibration and test conditions. Using the pitot static rake to calibrate the single pitot of an installed engine introduced flight thrust errors no larger and possible smaller. (3) Nondimensional thrusts at 35,000 ft were some 7 percent lower than corresponding thrusts at 5,000 ft. Further tests are required to establish the magnitude of these effects on other engine types.

N-21311*

Aeronautical Research Council (Gt. Brit.)
EFFECT OF THE CONTROL-CIRCUIT ON FLUTTER. (Einfluss der rudersteürung auf das flattern). K. Leiss. June 17, 1948. 50p. diagrs. (ARC 11,583; 0.734. Trans. from Zentrale für wissenschaftliches Berichtswesen der Luftfahrtforschung, Berlin. FB 1670, October 10, 1942)

As a result of the participation of the controls, the following types of flutter appear: when the control is slack there is flutter of the system with the control organ and the control surface out of phase, but when the control is stiff there is flutter with the two components in phase. The second type of flutter, in particular, has only been treated incompletely, if at all, up to the present; but because of its appearance the advantage of stiffening the control is doubtful. Mass-balancing of the control surface, and - with occasional exceptions - structural damping in the control system, improve the flutter properties, especially when the control organ and the control surface are in phase with each other. The oscillation of the controls is included in the flutter calculations by means of suitable transformations; this is done in such a way that little more computational work is involved than for the case where the oscillation of the control system is neglected.

N-21394*

National Gas Turbine Establishment (Gt. Brit.)
THE BURNING OF SINGLE DROPS OF FUEL. PART III. COMPARISON OF EXPERIMENTAL AND THEORETICAL BURNING RATES AND DISCUSSION OF THE MECHANISM OF THE COMBUSTION PROCESS. G. A. E. Godsave. August 1952. 47p. diagrs., photos. (NGTE R.88)

A theoretical and experimental investigation has been made of the factors influencing the rate of decrease in size of a single burning drop, as in a burning fuel spray. The experimental technique adopted in this investigation has been to suspend a single drop of fuel on a fine silica filament, and to measure with a cinematograph camera the rate of decrease in size during combustion in still air. A theoretical treatment given in part I indicates that the heat transfer to the drop is the dominant factor determining its life. The coefficient of heat transfer to the drop is itself a function of the mass evaporation rate. The analysis given enables a solution to be obtained for the heat transfer to the drop in the presence of the evaporative flow of the vapor. The experimental results presented in part II have been examined here in part III on the basis of such a heat-transfer relationship, with due allowance for any siginificant radiation effects. A discussion is given of the mechanism of the combustion process during the burning of a fuel spray.

MISCELLANEOUS

NACA TN 2278

Errata No. 1 on "THEORETICAL SYMMETRIC SPAN LOADING DUE TO FLAP DEFLECTION FOR WINGS OF ARBITRARY PLAN FORM AT SUBSONIC SPEEDS." John DeYoung. January 1951.

NACA TN 2770

Errata No. 1 on "STUDY OF THE PRESSURE RISE ACROSS SHOCK WAVES REQUIRED TO SEPARATE LAMINAR AND TURBULENT BOUNDARY LAYERS." Coleman duP. Donaldson and Roy H. Lange. September 1952.

UNPUBLISHED PAPERS

N-19881*

DIRECT-FORCE MEASUREMENTS OF TURBULENT SKIN FRICTION ON CYLINDERS IN AXIAL FLOW AT SUBSONIC AND SUPERSONIC VELOCITIES. Dean R. Chapman and Robert H. Kester. 1953. 20p. diagrs., photos., tab. (To be presented at annual Institute of the Aeronautical Sciences meeting, New York, January 26-29, 1953.)

The principal results of a study of all known theories for calculating turbulent skin friction in compressible flow are briefly reviewed. These various theories predict widely different effects of Mach number on skin friction, and hence also on heat transfer. Systematic experiments were made to determine the magnitude of turbulent skin friction along the cylindrical portion of cone-cylinder bodies of revolution having over-all fineness ratios of 10, 15, and 25. Data were obtained by directly measuring forces. Boundary-layer surveys were made to determine the correction necessary to apply to the force measurements in order to determine the effective starting position of the turbulent flow. Mach numbers between 0.5 and 3.6, and Reynolds numbers between 4 million and 32 million were investigated. At a Mach number of 2.0, data were obtained (by

distorting the flexible-plate walls of the wind tunnel) for three different pressure distributions in order to evaluate the effect of a moderate pressure gradient on turbulent skin friction.

DECLASSIFIED NACA REPORTS

NACA RM E52F06

MECHANISM OF START AND DEVELOPMENT OF AIRCRAFT CRASH FIRES. I. Irving Pinkel, G. Merritt Preston and Gerard J. Pesman. August 28, 1952. ii, 97p. diagrs., photos., 2 tabs. (NACA RM E52F06) (Declassified from Restricted, 2/27/53)

Full-scale aircraft crashes were made to investigate the mechanism of the start and development of aircraft crash fires. The results are discussed herein. This investigation revealed the characteristics of the ignition sources, the manner in which the combustibles spread, the mechanism of the union of the combustibles and ignition sources, and the pertinent factors governing the development of a crash fire as observed in this program.